

SA-CD FAQ

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This FAQ aims to be the most comprehensive FAQ concerning SA-CD on the web, but also independent, unbiased, practical and readable.

If you have any corrections, suggestions, or relevant questions that you don't see answered here, please address them to faq@sa-cd.net

Table of Contents

General

- [What is SACD?](#)
- [Who invented SACD?](#)
- [Is this FAQ officially endorsed by Sony or Philips?](#)
- [Whence the funny logo? It reminds me of Jugendstil/Art Nouveau/Science Fiction/Fantasy/Yes typography/<fill in your own association here>](#)
- [Surely SACD is something more akin to CD while DVD-Audio is something completely new, right?](#)
- [What is the Scarlet Book?](#)
- [Why is it called like that?](#)

Technology & Specifications

Discs

- [What is a hybrid SACD?](#)
- [So it's somewhat like a DualDisc then?](#)
- [Are all SACDs hybrid?](#)
- [Can I see the difference?](#)
- [What is the difference between a hybrid SACD and a Dual Layer SACD?](#)
- [Are all SACDs multichannel?](#)
- [Is the stereo signal derived from the multichannel signal?](#)
- [Do all SACDs contain a stereo mix?](#)
- [Is the content of the 'Red Book' CD and the SACD layer the same, apart from sound quality?](#)
- [What is PSP?](#)

Audio

- [What is DSD?](#)
- [How does DSD work?](#)
- [What is the difference between PCM and DSD?](#)
- [Wasn't CD supposed to deliver perfect sound?](#)
- [What is the difference between SACD and HDCD?](#)
- [What is the difference between SACD and DVD-Audio?](#)
- [Can I hear the difference?](#)
- [Which is better – SACD or DVD-Audio?](#)
- [I've heard people say the sound quality of DVD-Audio is worse than that of regular Audio CD. What are they talking about?](#)
- [How does multi-channel sound on SACD \(and DVD-Audio\) differ from surround sound on DVD-Video?](#)
- [What about DTS-CD?](#)

- [What is DST?](#)
- [What is DSD128?](#)
- [What is DXD?](#)
- [Will SACD and/or DVD-Audio be superseded by Blu-ray Disc or HD-DVD?](#)

Packaging

- [What is a Super Jewel Box?](#)
- [Are all SACDs packaged in Super Jewel Boxes?](#)

Practical use / Playback equipment

- [Can I play SACDs on my CD player?](#)
- [Can I play SACDs in my car?](#)
- [Can I play SACDs on my DVD player?](#)
- [Can I play SACDs on my HD-DVD or Blu-ray Disc player?](#)
- [Can I play SACDs on my games console?](#)
- [Can I play SACDs on my PC?](#)
- [Can I copy an SACD?](#)
- [Can I record my own SACDs?](#)
- [Can I output SACD audio via digital output?](#)
- [Are there any amplifiers or AV receivers that accept DSD input?](#)
- [How many SACDs are available?](#)
- [How do I find out if album X has been released on SACD?](#)
- [How many labels support SACD i.e. publish music on the format?](#)
- [Should I buy a CD/SACD player, a CD/SACD/DVD-Video player or a 'universal' CD/SACD/DVD-Audio/DVD-Video player?](#)
- [Do I need a special receiver/amplifier for connecting an SACD player?](#)
- [Do I need special speakers and cables for SACD?](#)
- [Do I need identical speakers?](#)
- [Do I need a subwoofer?](#)
- [Do I need to configure the speakers in a specific layout?](#)
- [Do I need special ears to enjoy the sound quality difference between CD and SACD?](#)
- [Do I need additional ears to enjoy multi-channel sound?](#)

References

- [Where can I read more?](#)

Glossary / list of acronyms

General

What is SA-CD?

SA-CD is short for Super Audio CD or, if you prefer, Super Audio Compact Disc – an optical music carrier that may or may not be intended to succeed the regular audio Compact Disc format introduced in 1983. In short it is designed to provide better sound quality, both in the form of higher fidelity and, optionally, in the form of multi-channel (surround) sound, while maintaining backward compatibility with CD. For more details, read on.

Who invented SA-CD?

SA-CD was developed by Sony and Philips. Who invented what exactly remains a secret shared between the two companies but is quite irrelevant. The trademarks are owned by Sony. Philips is the licensor of the disc format and the trademark.

Is this FAQ officially endorsed by Sony or Philips?

No, but we have run this FAQ against some experts in these companies to weed out any factual errors and get permission for using their illustrations.

Whence the funny logo? It reminds me of Jugendstil/Art Nouveau/Science Fiction/Fantasy/Tribal tattoos/Yes typography/<fill in your own association here>

The logo simply shows SA CD – the S and A in the upper half, the C and D in the lower half. Presumably the logo is meant to convey a sense of fluid, organic, natural curves as opposed to the straight, angular shapes of the Compact Disc Digital Audio logo, representing natural, analogue sound in contrast to the imperfect digital sound reproduced with the technology of 20 years earlier. This is however mere speculation.



Why is the acronym often written with a dash in it?

That's to distinguish SA-CD from SACD, la Société des Auteurs et Compositeurs Dramatiques – a French copyrights body.

What is the Scarlet Book?

Scarlet Book is the name of the official specification of the SA-CD format.

Why is it called like that?

Traditionally the books containing the format specifications of optical discs are named after a colour. A lot of names had already been used: Red Book (Audio CD), Yellow Book (CD-ROM), Orange Book (Recordable CD), Green Book (CD-interactive), White Book (Video-CD), Blue Book (Enhanced CD), even Rainbow Book (MiniDisc).

But there's more. Scarlet is not just red – it's a certain shade of red. Sony and Philips might also have called it the Crimson Book or Burgundy Book for all we know but it should be seen as a refinement of the Red Book that defined the original audio CD, often referred to as RBCD (for Red Book CD) or CD-DA for the official name 'Compact Disc Digital Audio'.

Technology & Specifications

Discs

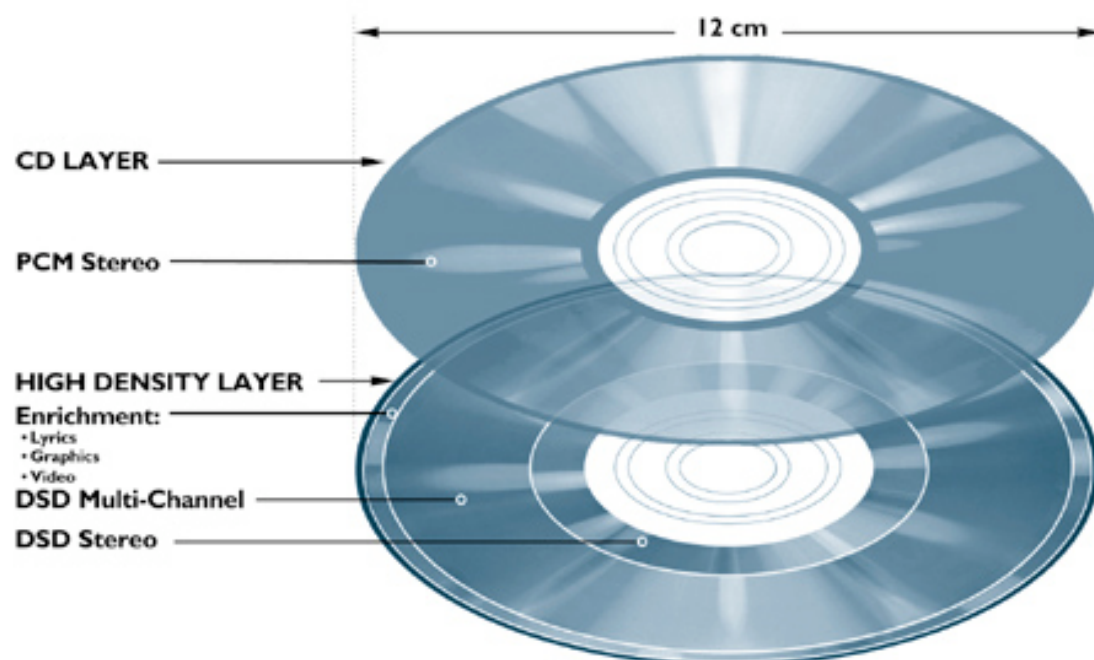
What is a hybrid SA-CD?

A hybrid SA-CD is an SA-CD disc that can be played on regular CD players. The sound quality in that case will, in principle, not be better than that of a regular CD

(though the CD-compatible layer is usually derived from the high resolution signal with SBM for better sound ... or similar words). The obvious benefit of a hybrid disc is that you don't need to replace all your CD players by SA-CD players at once. In fact you could even start collecting SA-CDs before you own a CD player.

Hybrid SA-CD works in a different way. Both the CD layer and the high-density layer are 'read' from the same side. The other side has a printed label, so it is easy to recognize the disc and place it correctly in the tray of the CD player. How it works? The high-density layer is partly reflective, partly transparent. At the wavelength used by regular CD layers (780 nm) the SA-CD layer is invisible so a CD player will just 'see' the CD layer. At the wavelength used for DVD and SA-CD (650 nm), the SA-CD layer is reflective.

Hybrid Disc Content



Are all SA-CDs hybrid?

In the early days of SA-CD, most titles were released as 'single layer' i.e. SA-CD-only but nowadays virtually all SA-CD releases are hybrid discs. Currently, more than 90% of the SA-CD catalogue consists of hybrid discs and this rate continues to rise.

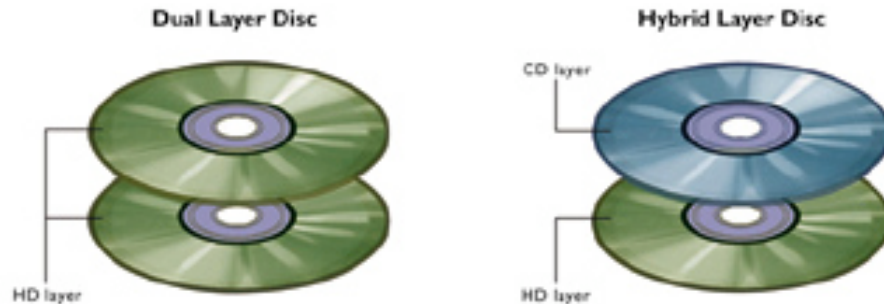
Can I see the difference?

Yes. Single-layer SA-CDs look 'plain silver' while hybrid ones have a goldish shine to them.

What is the difference between a hybrid SA-CD and a Dual Layer SA-CD?

A hybrid SA-CD consists of a CD and high-density layer while a Dual Layer SA-CD disc contains two high-density layers, making it incompatible with CD players. The option of a Dual Layer SA-CD, specified in the SA-CD standard, is intended to

provide more music capacity. Dual Layer SA-CDs are sometimes used for special surround demo discs or for long classical works.. They are relatively rare.



Are all SA-CDs multichannel?

No, especially in the beginning many SA-CDs released were stereo only. Nowadays most SA-CDs released are stereo plus multichannel. Two thirds of all SA-CD titles are multichannel and the general trend is up.

Is the stereo signal derived from the multichannel signal?

No. Unlike DVD-Audio, the SA-CD format does not support 'down-mixing'. When an SA-CD contains stereo and multichannel sound, these are stored separately on the disc.

Do all SA-CDs contain a stereo mix?

Nearly all of them do. There are a few examples of hybrid SA-CDs that contain a multichannel mix but no stereo mix in the SA-CD layer, even though the CD layer does contain a stereo mix. Examples are the budget SA-CD series by Universal's Eloquence label.

Is the content of the 'Red Book' CD and the SA-CD layer the same, apart from sound quality?

Not necessarily but in practice it generally is. In some cases you may notice slight variations in playing time.

What is PSP?

PSP is short for Pit Signal Processing – the most prominent copy protection measure of the SA-CD format. PSP is a physical watermarking feature that contains a digital watermark modulated in the width of pits on the disc (whereas data is stored in the length of the pits). The optical pickup must contain special circuitry to read the PSP watermark, which is then compared to information on the disc to make sure it's legitimate. Because DVD-ROM drives use an optical pickup that lacks this specialized watermark detection circuitry they cannot read the data on the high-density layer of a protected SA-CD disc.

Pit Signal Processing has nothing to do with PlayStation Portable, another PSP name coined by Sony.

Audio

What is DSD?

DSD is short for Direct Stream Digital, the way in which the analog sound signal is described in the digital domain. It was originally invented by Sony for archiving studios' master tapes with the idea that they shouldn't be left wondering ten years later why they hadn't used a better encoding scheme before transferring and discarding these masters.

How does DSD work?

Technical experts will tell you DSD is basically a 1-bit Delta/Sigma conversion scheme. We'll try explaining it in somewhat more understandable terms but cannot avoid using some technical terms too.

Basically it works as follows: DSD being a 1-bit signal means that every bit represents a sample – a measurement of the amplitude of the sound wave at a certain time. Since a bit can only have two values, every bit in a DSD stream only tells whether the amplitude of the sound signal was higher or lower than the previous sample. Because it doesn't tell *how much* higher or lower the amplitude is, you can imagine you need a lot of samples to accurately describe the signal. Well, DSD uses 64 times the sampling frequency of CD: 2.822 MHz vs 44.1 kHz. The factor 64 is not randomly chosen. It's a power of two, meaning that it's relatively straightforward to upsample from typical PCM frequencies including 44.1 kHz and multiples like 88.2 kHz.

What is the difference between PCM and DSD?

PCM (Pulse Code Modulation) is a very abstract way to describe an analog signal in a digital way but it's the best way that existed at the beginning of the eighties when CD was developed and introduced. In PCM, every sample consists of a combination of bits (typically between 14 and 24, depending on the carrier) describing the amplitude of the signal. The number of bits determines the resolution of how finely the signal can be described, where every added bit doubles the number of levels that can be distinguished.

Converting from analog sound to PCM and back to analog sound involves a fair number of processing steps, such as quantization. Every step can cause further distortions such as quantization noise, which has to be filtered out, in turn again deteriorating the sound quality.

DSD on the other hand is an extremely simple way of converting from analog to digital and back. The entire process is extremely transparent. In fact, the DSD bit stream is so closely related – perhaps analogous would be a proper term here – to the analog signal that if you were to feed it to a speaker (as a series of +1 and -1 values) you'd get back audible music.

Wasn't CD supposed to deliver perfect sound?

Yes, it was and it did represent the state of the art in 1982 – what could be put into a CD player but also what could be put on a practical, 12-cm optical disc – but technology has progressed and so has insight into human perception of sound. For instance, it only became apparent later that although the human ear cannot directly pick up frequencies above 20 kHz they are actually of importance for the way we hear sounds. SA-CD with DSD extends the frequency range towards 100 kHz.

A possibly more important difference between CD's 44.1 kHz 16-bit PCM sound quality and SA-CD's 2.8 MHz 1-bit DSD sound quality is the accuracy in the time domain. As it turns out, the human ear is extremely sensitive to minute timing differences. In fact, of the various cues our brain uses to determine the direction of sound sources, probably the most important cue is the difference in time it takes for a sound to reach our left ear versus the right ear. The sampling frequency of CD, 44,100 times per second is simply not good enough to reproduce a good 'sound stage' which is why you may find that the sound of a CD 'sticks to the speakers': you'll hear it coming from the left speaker and from the right speaker but there's nothing in between. This is an area in which DSD excels.

Furthermore, at 120 dB the dynamic range of SA-CD is much improved over CD. Above all, SA-CD provides the option of multichannel sound where Audio CD only offers stereo. More about that later.

What is the difference between SA-CD and HDCD?

HDCD (officially an acronym for High-Density Compatible Digital because the company that conceived this standard could not use a name that included 'Compact Disc') is a variant of the audio CD format that uses some otherwise unused 'subcode' bits to enhance the resolution slightly. It's an elegant approach in the sense that it provides the sort of two-way compatibility with CD like described for hybrid SA-CDs above: HDCDs can be played on regular CD players as if they were normal CDs: the player will simply ignore the extra bits.

While it provides an improvement over 'Red Book' CD it doesn't approach the fidelity of SA-CD, or of DVD-Audio, for that matter.

HDCD was developed by a company called Pacific Microsonics, later acquired by Microsoft.

What is the difference between SA-CD and DVD-Audio?

Although both aim or aimed to succeed the audio CD as preferred carrier for music by providing higher fidelity sound and multichannel sound, there are a number of important differences between the two formats.

- 1) Compatibility – SA-CD provides the option of compatibility with CD players by means of the hybrid disc (see '*What is a hybrid SA-CD?*' above). While this is an option, in practice all discs released nowadays are actually hybrid. Hybrid SA-CDs can also be played on plain vanilla DVD-Video players but only in 'Red Book' CD quality. DVD-Audio discs (other than Dual Discs) on the other hand are not compatible with CD players. The format does however mandate added tracks for compatibility with DVD-Video players. This can be in the form of Dolby Digital, DTS or high-resolution stereo PCM.
- 2) SA-CD uses DSD audio format while DVD-Audio employs PCM. The difference between DSD and PCM is explained above (see '*What is the difference between PCM and DSD?*'). Many variations are allowed in DVD-Audio content: sampling rates can be 48, 96 or 192 kHz; resolutions can be 16, 20 or 24 bits; the number of channels can go up to 5.1 – left, right, center, left surround, right surround and LFE (Low Frequency Effects). The creators of a DVD-Audio title however have to make a trade-off between these parameters: 5.1 channels at 192 kHz sampling rate with 24 bits resolution is not possible. A realistic combination for multichannel sound, for instance, is 96 kHz for the front channels and 48 kHz for the surround channels 24 bits resolution. For more details about possible

combinations refer here: http://en.wikipedia.org/wiki/DVD-Audio#Audio_specifications

- 3) On SA-CD, the multichannel and stereo DSD mixes are stored separately on the disc. The DVD-Audio standard allows the player to generate a stereo downmix from the multichannel mix.
- 4) SA-CD supports up to six channels at full bandwidth. Rather surprisingly, in its current form the SA-CD standard does not specify how the channels shall be used precisely. Multichannel discs use 3 to 6 channels
- 5) The SA-CD format permits additional data including text, graphics and video. In practice however, only the text option is used. It works similar to CD-Text in the Red Book CD format. While DVD-Audio is also purely an audio format, the DVD format allows combination of DVD-Audio and DVD-Video content on the same disc, even on the same side.
- 6) The catalogue of SA-CD spans over 4,500 titles with, on average, 70 new releases added per month.

Can I hear the difference?

While the difference between regular audio CD and the high-density layer of SA-CD can be quite easily perceived, even to untrained ears, the sound difference between SA-CD/DSD on the one hand and DVD-Audio/hi-res PCM on the other hand will be more subtle.

A few dozen titles have been issued on both formats so if you have a player that's compatible with both SA-CD and DVD-Audio you can try for yourself.

How does multi-channel sound on SA-CD (and DVD-Audio) differ from surround sound on DVD-Video?

Dolby Digital and DTS were developed for movie sound effects and are perfectly tailored for that but less suited for high-fidelity music reproduction. Both apply lossy compression (much like MP3 does), whereas the DSD signal used on SA-CD does not. A lossless compression scheme called Meridian Lossless Packing (MLP) exists for DTS but this cannot be used with the DVD-Video format, only with DVD-Audio. Of course, on DVD it's possible to use uncompressed PCM, even in high resolution up to 24 bit at 96 kHz, but DVD-Video only supports stereo PCM. Multichannel PCM is limited to the DVD-Audio format.

What about DTS-CD?

DTS-CD is a CD that contains 5.1-channel audio in DTS format (bit rate: 1,378 kbit/s). It does not contain PCM. It can be played on CD players with an 'SPDIF' digital output and on DVD players, in combination with an AV receiver that supports DTS decoding. See http://en.wikipedia.org/wiki/5.1_Music_Disc

What is DST?

DST is short for Direct Stream Transfer – a losslessly compressed variant of DSD. Lossless compression means every single bit from the original input stream is delivered at the output after decompression, just like a zipped file on your PC would

be reproduced bit by bit, only DST is unzipped on the fly. DST is used on multichannel SA-CDs .

What is DSD128?

DSD128 is DSD at twice the default sampling rate: 5.6448 MHz. DSD128 is used in some studios for editing. The normal DSD format is also called DSD64 where confusion is possible.

What is DXD?

DXD is short for Digital eXtreme Definition – a sound encoding scheme for professional use that was developed for editing high-resolution recordings because DSD is not ideally suited for editing. DXD is a PCM-like signal with 24-bit resolution sampled at 352.8 kHz – eight times 44.1 kHz. The data rate is 11.2896 Mbit/s – four times that of DSD.

What is Direct SBM and what has it got to do with SA-CD?

SBM is short for Super Bit Mapping – one of various methods for down-converting an audio signal from a higher resolution to a PCM signal with the desired resolution. It involves techniques known as dithering and noise shaping. *Direct* SBM is the method for converting a DSD signal to 16-bit 44.1 kHz PCM *in one step* in order to minimize noise because every decimation step potentially adds quantization noise. On hybrid SA-CDs with the Direct SBM label, the audio on the CD-compatible layer is derived from the DSD master using this process.

Will SA-CD and/or DVD-Audio be superseded by Blu-ray Disc or HD-DVD?

No, that isn't likely to happen. Blu-ray Disc (BD) and HD-DVD are aimed quite squarely at storage of (high-definition) video and secondly on data storage for computers. No audio-only variant of BD has been specified, and as far as we know DSD hasn't been included in the range of optional audio formats on BD. You may consider SA-CD to be the HD Audio complement to BD.

Both formats work with newer versions of the multichannel audio standards by Dolby and DTS: Dolby TrueHD and DTS-HD offering up to 7.1 channels of audio. Like Dolby Digital and DTS however, these audio formats are primarily designed for use with movies and employ compression techniques including matrixing that make them less suited for audiophile music reproduction.

Packaging

What is a Super Jewel Box?

A Super Jewel Box is a newer, improved version of the ubiquitous original jewel case used with the majority of CDs. You can recognize a Super Jewel Box by its rounded corners which are less prone to breaking when dropped, especially the hinges. Another improvement is that it permits visuals on all six sides, including the top and bottom surfaces. There are three versions: a compact version, used with SA-CDs, a medium-sized version, used with DVD-Audio discs and a tall version used with some DVD-Video discs, mostly music titles.

Are all SA-CDs packaged in Super Jewel Boxes?

No, some SA-CDs are packaged in traditional jewel cases, digipacks or other forms.

Do Super Jewel Boxes always contain SA-CDs?

No, a Super Jewel Box is certainly no guarantee for an SA-CD, especially since Universal Music has started using them for many most of their new releases in 2006.

Practical use / Playback equipment

Can I play SA-CDs on my CD player?

Hybrid SA-CDs you can play on every CD player. Only single-layer SA-CDs cannot be played on regular CD players. See *'What is a hybrid SA-CD?'* above.

Can I play SA-CDs in my car?

Of course if you have a regular car CD player you can play the CD-compatible layer of hybrid SA-CDs. If you want to enjoy them properly however you'll need a car SA-CD player. Since Q1 2007, Sony has a range of such players for the 'aftermarket', including stereo as well as multichannel models.

As of the same quarter, Bose has announced a 'universal media player' for cars, supporting SA-CD as well as DVD-Audio. This, on the other hand, is a line-fit model, i.e. factory-installed. Thus far it's only available in one Ferrari model.

Can I play SA-CDs on my DVD player?

Most DVD players simply recognize (and play) an SA-CD as a CD. A few early models can be confused because before they spot the CD layer they detect a DVD layer with content that they can't decode.

Can I play SA-CDs on my HD-DVD or Blu-ray Disc player?

So far no HD-DVD player with SA-CD support has been announced and the only SA-CD-compatible Blu-ray Disc player is Sony's PlayStation 3.

Can I play SA-CDs on my games console?

Hybrid SA-CDs can be played as CDs on all consoles that support 'Red Book' audio CD. The high-density layer will only play on a PlayStation 3. The output is only stereo via the analog AV out. The SPDIF output is silent during SA-CD playback. Multichannel audio is available only via HDMI but at the time of writing it's not clear whether the signal is DSD or PCM. Presumably it is the latter. It may be high-resolution.

Can I play SA-CDs on my PC?

The SA-CD layer cannot be played in any PC drive – not even in those Sony VAIO PCs that support DSD audio. The CD-compatible layer of hybrid SA-CDs can be played but some early CD/DVD drives have difficulties due to misdetection (mistaking the high-density layer for a DVD). Pure CD-ROM and CD-R/RW drives that do not support DVD will work reliably.

Can I copy an SA-CD?

Never say never but so far SA-CD's copy protection measures have not been cracked. Besides, you cannot buy SA-CD recordable discs nor SA-CD writer drives. Copying the CD-compatible layer of a hybrid SA-CD will be possible on an audio CD recorder

if it is not protected with SCMS. It may also be possible on PCs; see '*Can I play SA-CDs on my PC?*' above.

Can I record my own SA-CDs?

No. You can neither buy SA-CD blanks nor recorders. Making SA-CDs involves studio equipment (a process called 'quick mastering') or industrial replication machines. For more information refer to SonyDADC.com, CrestDigital.com, Sonopress.com and MediaHyperium.com

Can I output SA-CD audio via digital output?

There are various types of 'digital outputs':

- SPDIF (coaxial or optical digital audio output) is not compatible with DSD; only with PCM (IEC- 60958) and MPEG2 Multichannel, Dolby Digital & DTS (IEC-61937). Reportedly some Sony SA-CD players perform down-conversion to PCM 88.2 kHz, a sampling rate which is officially not part of the SPDIF spec but in practice supported by many AV receivers nowadays.
- i.LINK, also known as FireWire and IEEE1394 can carry DSD audio in a secure way but there are few devices (SA-CD players and AV receivers) that can handle this.
- HDMI supports DSD audio from version 1.2 up. PlayStation3 uses version 1.3 of HDMI but it is uncertain whether it supports DSD output. See '*Can I play SA-CDs on my games console?*' above.

Are there any amplifiers or AV receivers that accept DSD input?

There are two digital connections that can provide DSD input:

- i.LINK with DSD is not a common feature (yet) but it's available on various receivers, including Sony's STR-DA9000ES, Pioneer's VSX-59Txib and Yamaha's Yamaha RX-Z9.
- HDMI from version 1.2 up supports DSD but although several receivers are compatible with this HDMI version, so far few of them decode DSD. Models that do include Marantz SR7001 and SR8001 receivers and Yamaha's DSP-AX761.

How many SA-CDs are available?

There are so far about 4,500-5,000 releases worldwide. Some early titles are no longer available. About 4,000 of these can be ordered from vendors and third-party sellers linked to SA-CD.net.

How do I find out if album X has been released on SA-CD?

Check the database on www.sa-cd.net – it's the most comprehensive list of SA-CDs on the web.

How many labels support SA-CD i.e. publish music on the format?

At the time of the most recent update 429 labels have released one or more SA-CDs.

How many brands support SA-CD i.e. make SA-CD players?

The total number we do not know – it keeps growing and some of the manufacturers are quite esoteric companies that aren't always easy to spot. A list can be found here but we do not know how up-to-date this list is: <http://audiotools.com/sacd.html>
Brands include: Accuphase, Alouette Audio, Audio Aero, Bladelious Design, Bel Canto Designs, Classé, dCS, Denon, Esoteric, Faroudja, Krell, Lexicon, Linn, Luxman, Marantz, McCormack, Micromega, Musical Fidelity, Music Hall Audio, Onkyo, Opera Audio, Philips, Pioneer, Primare, Revox, Shenzhen Shanling, Sharp, Sony, Theatris, Van Den Hul and Yamaha.

How many models of SA-CD players are currently on the market?

A statement by Sony from early 2006 suggested a global installed base of more than 13 million Super Audio CD players, with in excess of 180 models currently available from 37 manufacturers. We know of no information that contradicts this.

Should I buy a CD/SA-CD player, a CD/SA-CD/DVD-Video player or a 'universal' CD/SA-CD/DVD-Audio/DVD-Video player?

That's a matter of preference. Advantages of 'universal' players obviously include compatibility with more media using fewer devices but as a drawback you may feel the video circuitry distorts the audio. Even if the device offers the possibility to disable the video circuits you may still feel it's surely a compromise. In that case, or when you don't object to having multiple devices for your various media, or if you listen to music and watch movies in different rooms, a dedicated CD/SA-CD audio player may be your best choice. Otherwise you'll probably find the combined player more convenient.

Do I need a special receiver/amplifier for connecting an SA-CD player?

In terms of connections: It depends on whether you want to connect an SA-CD player with multichannel output rather than just stereo. If so, you'll need a receiver with multichannel input: depending on the SA-CD player's outputs you may use i.LINK or HDMI (see '*Are there any amplifiers or AV receivers that accept DSD input?*') but the most obvious (though not the most convenient) solution is using 6 analog connections. This is common on all modern AV receivers but truly audiophile amplifiers in many cases are still stereo.

Concerning fidelity: there are definitely sound quality differences between receivers but it must be said that even an affordable, mainstream receiver can let you hear the difference between CD and SA-CD. When it comes to accuracy in the time domain (see '*Wasn't CD supposed to deliver perfect sound?*') the receiver is usually not the bottleneck (nor are the speakers): the carrier is. There are exceptions: some receivers internally convert analog signals to PCM in order to do processing in the digital domain. Depending on the design, this may be PCM of RBCD quality: 16-bit resolution and 44.1 or 48 kHz. Of course, the benefit of DSD is lost then. Some of these receivers allow bypassing these conversion steps (at the expense of equalizing and other adjustments) but do stay alert.

Do I need special speakers and cables for SA-CD?

Of course, for a multichannel speaker configuration you'll need more speakers and cables than for a stereo setup. Regarding quality, the same counts as for the amplifier: even with mainstream speakers and cables you'll be able to appreciate the sound quality improvement of SA-CD over CD, because the wires will typically not be the

bottleneck. Once you have upgraded other parts of your chain (the player, the music carriers) you may however become more critical of your speakers and cables, and there is no limit as to how far you can go.

Do I need identical speakers?

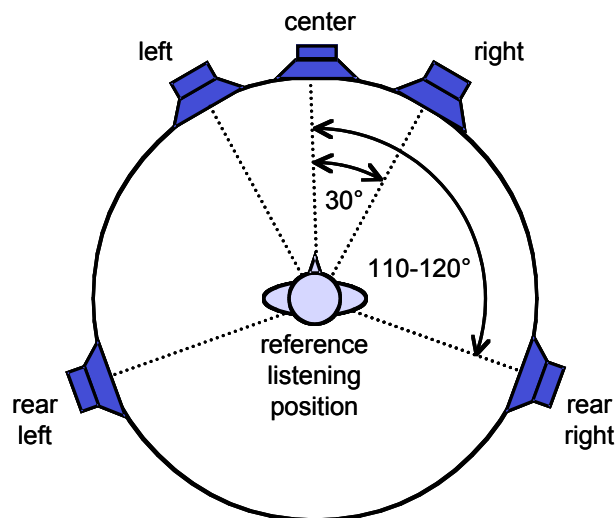
Many home theater systems are primarily designed for use with Dolby Digital and DTS where having relatively small surround speakers and larger is perfectly normal, often supported by a setting on the receiver to switch between identical speakers and larger plus smaller speakers. Multichannel SA-CD is best enjoyed with five identical speakers (plus an optional subwoofer; see the next question) or at least with rears from the same speaker family but that doesn't mean you won't be able to enjoy great sound until you've upgraded all of your speakers.

Do I need a subwoofer?

This depends on your taste as well as your receiver. Note that even multichannel titles often do not use the .1 channel. If you're not using a subwoofer it's helpful if your receiver has a feature called 'bass redirection', to make sure you don't miss too much. Some SA-CDs include a duplicate of the bass signal on the .1 channel for use with sub-sat systems which will need to be attenuated or disabled on full range systems.

Do I need to configure the speakers in a precise layout?

Sony and Philips recommend the following configuration for multichannel SA-CD:



Where the subwoofer is placed is not critical: with low sounds, due to their long wavelength, it's practically impossible to tell where they come from.

If you plan to use your setup also for watching movies you'll be glad to hear this layout is quite compatible with Dolby Digital and DTS 5.1

It's not a disaster if the angles don't match exactly, for instance if the rear speakers are further to the back. More critical probably is the distance of all speakers. A perfect circle ensures identical travel times for the sound from all speakers. For Dolby Digital and DTS, AV receivers often offer time delay settings to compensate for varying distances but because DSD sound (and analog sound) are much more difficult to process in such ways, for SA-CD you'll probably not be able to use this feature.

With all of the sound questions above there is one advice that always holds true: Rely on your own ears. Listen and judge for yourself.

Do I need special ears to enjoy the sound quality difference between CD and SA-CD?

No, you don't need golden ears. Even untrained people can fairly easily notice and appreciate the difference between 44.1-kHz 16-bit PCM and 2.882 MHz 1-bit DSD – also in stereo. Even people who are deaf on one ear have said they notice how SA-CD sounds more natural than CD.

Do I need additional ears to enjoy multi-channel sound?

No, even with just two ears, humans have a remarkable capability to tell the direction sounds come from – a trait we probably developed in ancient times when this contributed significantly to our chance of survival.

References

Where can I read more?

About SA-CD in general:

- Sony/Philips white paper: <http://www.sel.sony.com/SEL/consumer/dsd/dsd.pdf>
- Wikipedia: http://en.wikipedia.org/wiki/Super_Audio_CD
- Sony Music SA-CD FAQ: <http://www.sonymusic.com/sacd/faq/index.html>

About professional issues regarding SA-CD (authoring, mastering, manufacturing, etc.):

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About DSD:

- Wikipedia: http://en.wikipedia.org/wiki/Direct_Stream_Digital

About DXD:

- http://www.digitalaudio.dk/technical_papers/axion/dxd%20Resolution%20v3.5.pdf

About DVD-Audio:

- Wikipedia: <http://en.wikipedia.org/wiki/DVD-Audio>
- Dolby DVD-Audio FAQ: http://www.dolby.com/consumer/home_entertainment/music_dvdaudio_faq.html

About DVD-Video and the DVD format in general:

- DVD FAQ: <http://www.dvddemystified.com/dvdfaq.html>

About 'universal' SA-CD/DVD-Audio players:

- http://dvda-sacd.webcindario.com/en/dvda-sacd_players.html

Glossary / list of acronyms

- AAC: Advanced Audio Codec – an audio encoding scheme, used for instance by iTunes/iPod
- CD: Compact Disc
- DSD: Direct Stream Digital – the audio encoding scheme used on SA-CD
- DST: Direct Stream Transfer – lossless compressed DSD
- DTS: Digital Theater Systems – a company and their standard for multichannel audio, primarily for movies
- DVD: just ‘DVD’; refer to [DVD FAQ](#)
- DXD: Digital eXtreme Definition: a PCM-like high-resolution audio encoding scheme for professional editing
- FAQ: Frequently Asked Questions – what you’re looking at
- HDMI: High-Definition Multimedia Interface – a digital A/V interface
- i.LINK: IEEE1394 aka FireWire
- IEC: International Electrotechnical Commission – a standards body whose standards include those for SPDIF
- MLP: Meridian Lossless Packing – an audio encoding scheme used on DVD-Audio
- MP3: MPEG1 Audio layer 3 – a popular but lossy audio compression standard
- MPEG2: a multichannel audio encoding scheme standardized by the Motion Pictures Expert Group along with video encoding schemes
- PCM: Pulse Code Modulation – the audio encoding scheme used on RBCD and on DVD-Audio
- PSP: Pit Signal Processing – a digital watermark feature used on SA-CD
- RBCD: Red Book CD – the original Compact Disc Digital Audio standard that defines regular audio CDs
- SA-CD: Super Audio CD
- SBM: Super Bit Mapping – a method for downconverting (to) a PCM signal
- SCMS: Serial Copy Management System – a 2-bit system that indicates whether a CD may be copied freely, once, or not at all
- SPDIF: Sony/Philips Digital Interface – the interface commonly known as optical and coaxial digital audio input/output

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